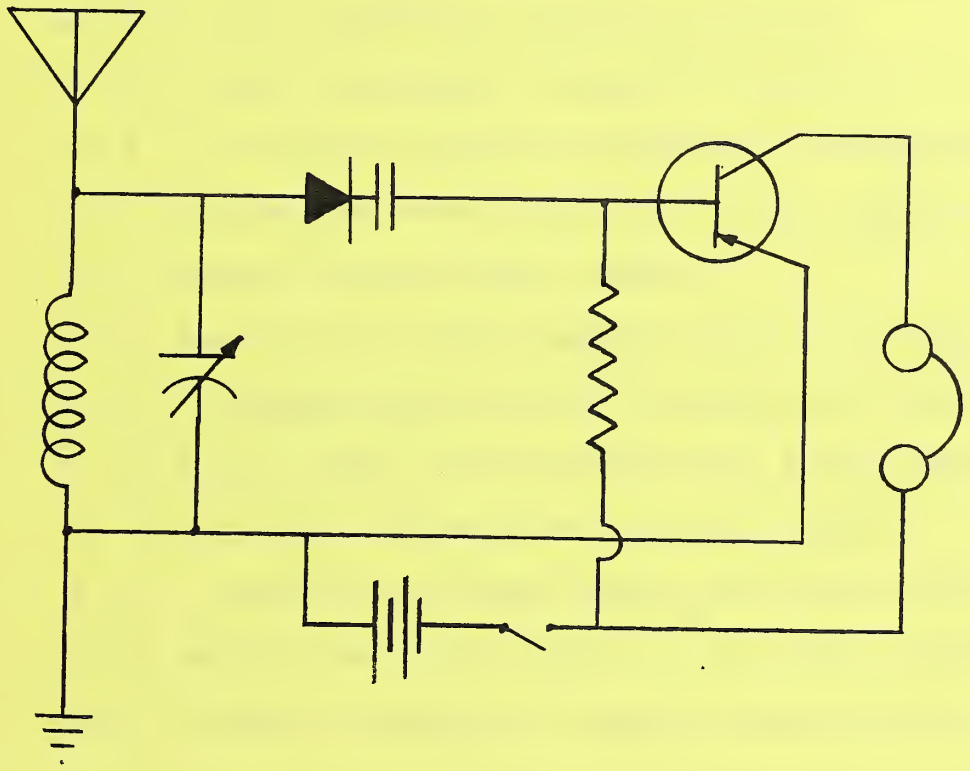
ELECTRICITY-ELECTRONICS

12

22 A B C

32 A B C



Alberta
EDUCATION

1975

A C K N O W L E D G E M E N T S

The Department of Education acknowledges with appreciation the contribution of the following Ad Hoc Committee members to the preparation of this Guide.

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NOTE: <u>This Curriculum Guide is a service publication only.</u> The Senior High School Program of Studies contains the official statement concerning Senior High School Electricity-Electronics. The information contained in this Guide is prescriptive insofar as it duplicates that contained in the Program of Studies. This Guide contains content, methods of developing the concepts, suggestions for the use of teaching aids and lists of additional reference books.

TABLE OF CONTENTS

I. INDUSTRIAL EDUCATION

Industrial Education is a program consisting of courses which provide a continuum of experiences, starting with exploratory activities in the junior high school and expanding in the high school to the development of skills related to career fields. This development of the student's skills is planned for through courses in Industrial Arts and Vocational Education culminating in on-the-job work experience, or entry into a job or post-high school institution for further education.

The program consists of courses ranging from those designed for an exploration of the technologies and trade areas to units of practical preparation for a career. In the process the courses develop the student's knowledge of himself, his talents and his skills.

The Industrial Education course "guides" provide the teacher with an outline of the topics, generalizations and concepts selected as most relevant for the physical and mental development of the students and the logical development of the subject area in accordance with the resources of the school in both teaching personnel and facilities.

The Guide leaves much scope for the teacher to develop content related to the topics, especially in writing behavioral objectives describing specific changes in student behavior anticipated from the learning tasks.

It is expected that each school district will develop a program of Industrial Education appropriate to the fulfilment of the needs of its student clientele.

II. OBJECTIVES

A. Industrial Education Objectives

The general objectives of Industrial Education complement the aims and objectives of the secondary school. The objectives of Industrial Education are to:

1. Provide students with the curriuclum content designed todevelop fundamental tool and procedural skills which help prepare them to enter a family of occupations.

2. Provide students with courses that serve as vehicles which help them to relate their academic knowledge to vocational competencies.

3. Provide students the opportunity to develop basic competencies, both academically and in work skills to enter either a job or a post-high school institution for further education.

4. Provide students with the environment whereby they may develop sound attitudes and acceptable work habits, and achieve a feeling of accomplishment.

B. Electricity-Electronics Career Field Objectives

The Electricity or Electronics courses should provide a student the opportunity to:

1. Gain an understanding of the career field.

2. Develop skills and knowledge necessary for job entry or articulation with post-high school institutions.

3. Develop and strive to achieve standards of performance acceptable to the industry.

C. Major Area of Study Objectives

The specific objectives of the Electricity-Electronics program are in harmony with the purposes of the Industrial Education Program and are as follows:

The Electricity-Electronics courses shall provide students the opportunity to:

1. Learn and work in an environment that enables them to make a realistic assessment of themselves, their interests and aptitudes as they relate to Electricity-Electronics.

2. Develop habits and attitudes acceptable to the trade concerning safety, working relationships, and efficient use of time and material.

3. Develop basic competencies in the use of tools, materials, and processes that may be used to gain advanced placement in apprenticeship, technical institute programs or on the job..

III. EVALUATION

Evaluation of student growth should be based on stated behavioural changes and specific criteria understood by students. Allowance should be made for both self and teacher evaluation and in some cases peer evaluation. Evaluation should further be based on the three domains of learning as defined by an Alberta committee of Industrial Education teachers. Their categories are as follows:

a. Verbal and Written Communication

b. Personal Growth

c. Manipulative Skills

The weighting given each of the three measures will depend on the nature of the behaviour being evaluated. For a more detailed treatment of evaluation see the Industrial Education Handbook.

IV. ORGANIZATION

A. Guide Organization

The course Guides are developed on the following pattern:

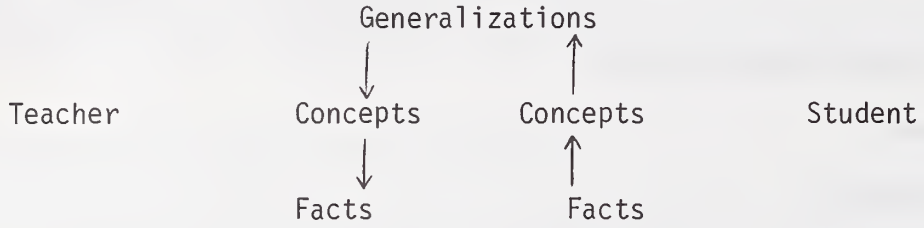
1. Introduction:
   -objectives
   -content summary
   -references

2. Content
   (1) Topic: Each course is subdivided into a number of topics.
   (2) Generalization: The main generalization or "big" idea that students should learn follows each topic.
   (3) Concepts: The concepts divide the topic into the teaching components. They give more direction on specific areas that should be studied.
   (4) Behavioural Objectives: These describe specific changes in student behaviour which result from learning tasks he performs.

   The Guide gives only a few sample behavioural objectives. <u>It is the responsibility of the teacher to develop as many behavioural objectives as he can teach in the time available.</u>

Facts are taken to be items of specific information, concepts are categories of information and generalizations express the relationship between concepts.

In planning a lesson, the teacher moves down this hierarchy whereas in learning the student begins with facts and moves upward.



(5) Suggested Activities: A few suggestions are made as to the types of activities that could be used to achieve the behavioural objectives.

(6) Resource Materials: This column suggests where materials may be obtained. Teachers may add to this list as they discover new materials.

B. Program Organization

1. Program Description

The Electricity-Electronics modules give students the opportunity to learn the theory and skills necessary in the trade. The student will learn to identify and use the tools of the trade to perform the major tasks related to the installation, servicing and repair of electrical products. Their activities may range from experimental work to installing and repairing equipment. In the process they will learn about the trade, job opportunities, business practices, and enough skills to get a job, go into apprenticeship, higher institutes of learning, or enhance their avocational interests.

2. Course Organization

The major is divided into six five-credit modules and one module of five-ten credits. Two of these are common to both majors. Entry into the major is through Electricity-Electronics 12 or General Technology 10. The sequence for Electricity is very flexible. However students must take 22A before 32B.

In Electronics, 22A is a prerequisites to 22B, 22C and 32B. Also students should take 22C prior to 32B.

The module 32C is the last course in the 35 credit sequence and can be used to:

a. provide greater depth to a module taken previously.

b. gain experience in actual construction under a work plan whereby the Electricity-Electronics teacher coordinates the student's program. The student must be under the supervision of a journeyman or tradesman while on the job.

In addition to the modules set out in the major for Electricity-Electronics a student may select modules designated as minors. These are normally the first level or introductory course of the area, e.g. the module in Automotives would be Mechanics 12.

A student wishing to meet the requirements of the Apprenticeship Branch must complete all seven modules in the major area in Electrity.

Some students, however, may take only a few modules in a major area as a supplement to their academic program or they may broaden their selection to other career fields. The scope of the Industrial Education program allows the flexibility necessary for the program to be tailored to meet the interests and needs of the individiual class or student.

The chart on Page 7 gives a graphic description of the Electricity-Electronics program. Each module is identified and the sequences are indicated by lines, e.g. after a student has completed one of Electricity-Electronics 12 or Industrial Education 10 he/she may advance to 22B, 22C or 32A. In the case of Electronics he may advance to 32B (Digital Logic) or 22A. All modules leading to 32C must be completed prior to taking Module 32C.

Once a student has enroled in a "22" or second level course he may also select modules from the minor fields. Minors for which grants are available are listed on the chart.

Students may find some of the courses in the listed related fields beneficial to their career program development. They are encouraged to take them even though these related courses are not supported by special grants.

C. Facility Organization

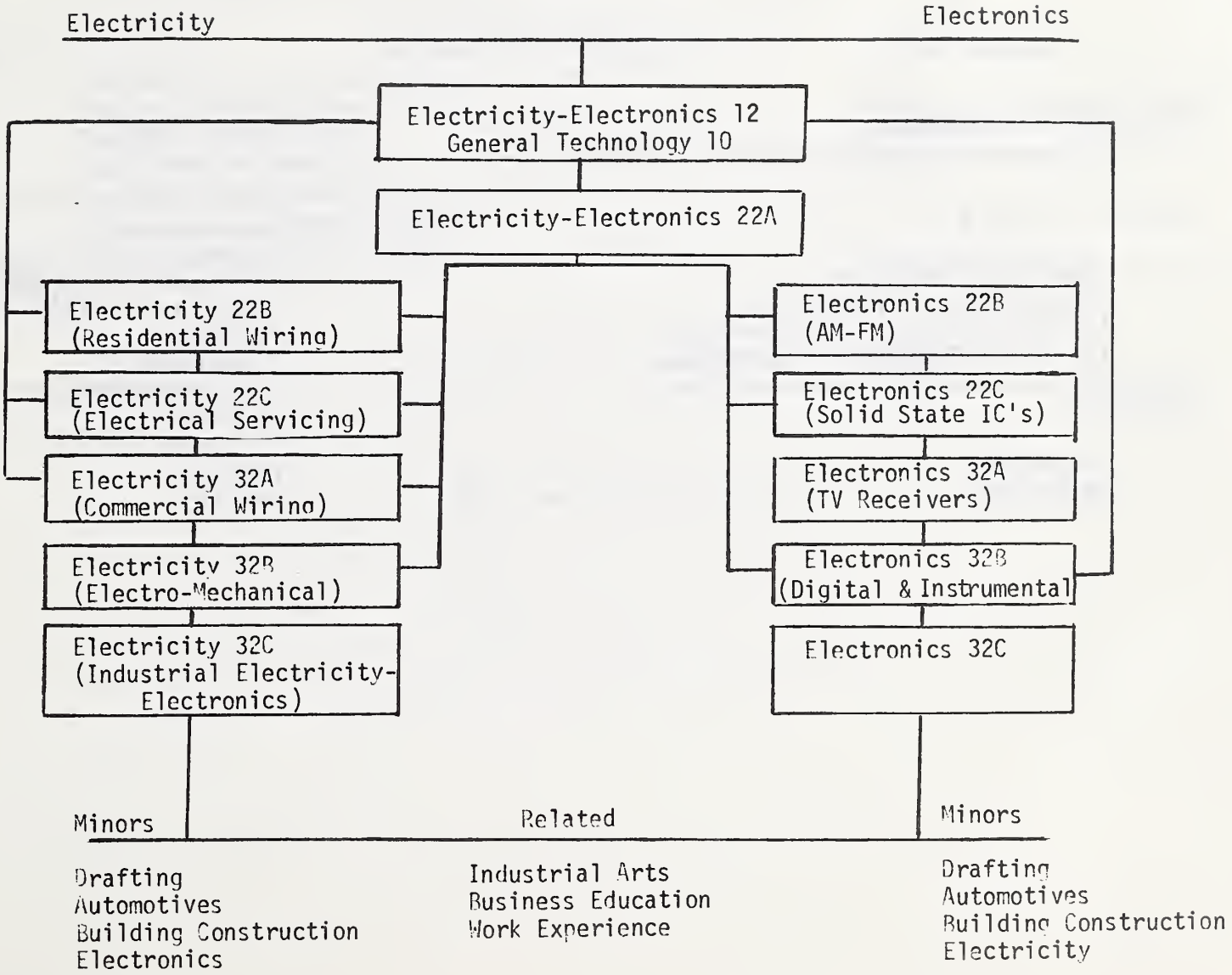
The organization of the physical facilities is in part determined by the original plan. There are however adjustments that can be made in the layout by the teacher to accommodate his/her style of teaching. The number of students in a class affects the way the lab or shop is organized. While most of the shops in Alberta are designed for 16 to 20 students a number of factors must be considered in the final assignment of class load. These factors include:

1. physical size of the shop or laboratory
2. type of student
3. amount of equipment
4. type of programming
5. type of course
6. training and experience of the teacher.

Safety of the students and their opportunity to obtain teacher contact are important considerations when class leads are determined.

CAREER FIELD

ELECTRICITY-ELECTRONICS



V. CAREER OPPORTUNITIES

Students taking all or most of the modules in the Electricity or Electronics major may look forward to the following opportunities:

A. Electricity (35 credits)

Post-High School Studies

N.A.I.T. or S.A.I.T.

- Electrical Technology
- Communications Electrician
- Air Conditioning & Refrigeration
- Electrical Engineering Technology

UNIVERSITY

- Engineering
- Education

Career Entry

- Electrical Mechanical Technician
- Apprenticeship
- Journeyman Electrician
- Appliance Serviceman
- Power Electrician
- Foreman
- Shop Owner
- Electrical Draftsman
- Salesman

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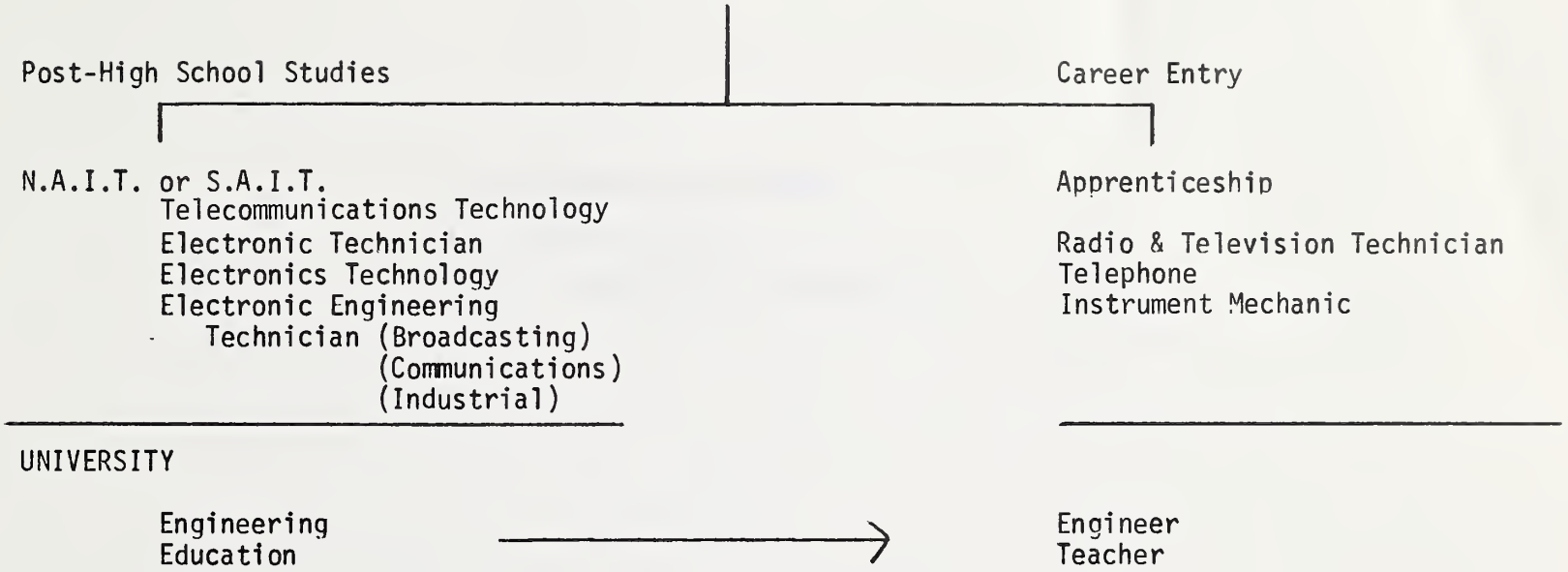
- Engineer
- Teacher

B. Electronics (35 credits)



VI. ELECTRICITY-ELECTRONICS

A. Common Modules

1. Electricity-Electronics 12

INTRODUCTION

The introductory Electricity-Electronics course is a four or five credit course which leads into either electricity or electronics.

I. OBJECTIVES

The objectives of Electricity-Electronics 12 are:

1. to provide students with an orientation to the technical and industrial environment
2. to provide students with information about opportunities in the fields of electricity and electronics
3. to provide students with the electrical theory required to advance to other related courses.

II. CONTENT SUMMARY

1. Career field study
   -occupational information
2. Safety and first aid
3. Electricity
   -definition and sources
4. Conductors and insulators and semiconductors
5. Magnetism and electromagnetism
6. Electrical units and measurement
7. Electric circuits
8. Symbolic representation of electric components
9. Electrical laws; Ohm's, Power, Kirchoff's
10. Soldering and making connections electrical circuits

11. Systems study
    -audio
    -electrical distribution
    -generation plants
    -broadcast receiver
    -others that are appropriate

III. REFERENCES AND RESOURCE MATERIALS

No one text is prescribed, however, those marked * are considered most valuable as such.

* Long, F. *Intermediate Electricity*. Don Mills, Ontario: General Publishing Co., 1965.

* Shick, Kurt. *Elements of Electricity and Electronics*. Toronto, Ontario: McGraw-Hill Company of Canada Ltd.

Van Valkenburgh. *Basic Electricity*. New York: Nooger & Neville, Inc. and John F. Rider Publisher, Inc.

Miller, Rex, Fred W. Culpepper, Jr. *Energy, Electricity and Electronics*. Illinois: McKnight & McKnight Publishing Company, 1964.

No one single laboratory manual prescribed - some experiments may be extracted from

Basic Electricity and *Basic Electronics* manuals by Zbar.

Brouwers. *Electrical and Electronic Technology*. General Publishing.

Schultz. *Basic Electricity*. Macmillan Co.

Gerrish. *Exploring Electronics*. General Publishing.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic I: CAREER FIELD

Major: Electricity-Electronics

Generalization A: Occupational information and a knowledge of employment opportunities in the Electricity-Electronics career field will help the student determine his educational and vocational endeavors.

Course: Electricity-Electronics 12

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Occupational Information		The student will:		
(i.) Awareness of employment opportunities		a. search out job opportunities, basic requirements and determine his interest to help plan his high school program.	Discuss career field opportunities. Use occupational information and films to show types of careers available.	
(ii.) Future opportunities		b. given more information on course content, outline the vocation he would like to prepare for.	Discuss course content of courses that follow.	
		c. list the opportunities within a career field - installer, electrician, technician, technologist, engineer, mechanic, serviceman.		
(iii.) Articulation		d. explain how this course articulates with requirements of other institutions.	Discuss the technical and apprenticeship articulation.	

Notes:

Topic II: SAFETY AND FIRST AID

Generalization B: Safety is of prime importance to the well being of persons and the protection of equipment.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Unsafe Act		The student will:		
		a. list the consequences of unsafe acts in Electricity-Electronics as they relate particularly to: (i.) live circuits (ii.) amperage (iii.) proper grounding (iv.) protective clothing.	Discuss shop behavior and safety procedures to be observed.	
2. Unsafe Condition		b. discuss how to identify conditions which could lead to injuries on the job.		
3. Safety Standards and Codes - Federal - Provincial - Local		a. safety standards and codes as opportunities arise.	Perform experiments in compliance with the electrical code. Demonstrate procedure for face replacement, circuit breaker reset, thermo cutout reset. See Unsafe Acts and Conditions IAVEC - ATA Reference to publication on safety.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. First Aid		a. remove a person from a line and administer artificial respiration. b. treat a person for medical shock.	Discuss and show safety film. Practice several methods of artificial respiration, obtain safety demonstration films.	

Notes:

Generalization C: A knowledge of what electricity is, nature of its behavior and sources of it is basic to observing and understanding the electrical phenomenon.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Electricity		The student will:		
		a. define static and dynamic electricity and demonstrate the law of charges.	Charge pith balls, demonstrate and discuss their behavior.	
		b. describe the nature of a charge from the structure of the atom and charged atoms.		
		c. differentiate between static and dynamic electricity.	Demonstrate, measure and observe AC pattern on a scope.	
		d. define and differentiate between AC and DC.	Observe other waveforms-square etc.	
2. Sources of Electricity		a. given the necessary equipment demonstrate six basic sources of electricity and the nature of electrical energy produced - AC or DC.	Discuss, demonstrate and experiment with various sources of electricity.	

Notes:

Topic IV: CONDUCTORS AND INSULATORS

Generalization D: Control and behavior of current is determined by the nature and condition of current path.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Conductors		The student will: a. define conductors in terms of ease of current flow. b. define conductors in terms of atomic structure.	Set up demonstrations showing charge in current flows through different materials.	
2. Insulators		a. define insulators in terms of: (i.) ease of current flow (ii.) atomic structure. b. explain the different conductivity of different material conductors. c. discuss the effects of lengths, diameter, material and temperature on the conductivity of conductors.	Demonstrate the effects on current flow of different lengths, diameters and nature of material of conductors.	
3. Semiconductors		a. distinguish among conductors, semiconductors and insulators in terms of: (i.) ease of current flow (ii.) atomic structure-number of electronics in outer orbit.	Using models of atomic structure or diagrams, show the atomic structure of conductors, semiconductors and insulators.	

Notes:

Topic V: MAGNETISM AND ELECTROMAGNETISM

Generalization E: Magnetism and electromagnetism are basic to motor action, induction and generator action.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Magnetism		The student will: a. explain why a bar can be magnetized: (i.) Electron Theory (ii.) Domain Theory.	Using an overhead projector and iron fillings with magnets, demonstrate: (1) magnetic field around a magnet (2) attraction-repulsion fields (3) motor action as a result of attraction or repulsion - applications, e.g. meter movement. Demonstrate - using left hand rule, rule and compasses.	
2. Motor Action		a. memorize the laws of attraction and repulsion. Explain:		
3. Electromagnetism - the magnetic effect of current		(i.) that associated with current there is a magnetic field (ii.) the polarity of this field can be determined by the Left Hand Rule. b. define an electromagnet and explain what determines its strength.	Discuss and show practical applications of electromagnets. Make electromagnets.	

Notes:

Topic V: MAGNETISM AND ELECTROMAGNETISM (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		c. determine the magnetic polarity of a current carrying coil.		
4. Induction		a. explain induction.		
		b. give examples of electro-magnetic induction-motor, generator, transformer.		
5. Generator Action		a. acquire knowledge and understanding of generator action.	Demonstrate and discuss generator action of a coil rotating in a magnetic field.	

Notes:

Generalization F: The volt, ohm, ampere and watt are basic in component and circuit measurements.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Volt - Unit of electrical pressure		The student will: a. use a volt-meter to measure voltage (Potential difference, emf, electrical pressure). b. correctly use a volt-meter.	Measure the voltage of cells, cells in series and parallel as power supplies and batteries measure variable power supply outputs and voltage drops.	
2. Ohm - Unit of electrical resistance or opposition		a. demonstrate: (i.) how to use an ohmmeter and read color coding of resistors (ii.) how to prolong the life of an ohmmeter (iii.) how to use an ohmmeter as a continuity checker.	Select various resistors, determine rated value and then measure their value with an ohmmeter.	
3. Ampere - Unit of electrical current flow		a. use an ammeter to measure current flow and precautions to be observed to safeguard the ammeter. b. define an ampere as a Coulomb per second.	Experiment with circuits with different amounts of current flow.	

Notes:

Topic VI: ELECTRICAL UNITS AND MEASUREMENT (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. Watt - Unit of electrical power		a. use and identify a wattmeter and study its hook-up.	Demonstrate hook-up and measurement of wattage of lamps, resistors and loads in electrical circuits.	
		b. read the power consumed on a commercial wattmeter.	Read the domestic wattmeter at home over an interval of time. Find out cost of power and calculate cost of consumption over this interval of time.	

Notes:

Topic VII: ELECTRIC CIRCUIT

Generalization G: The basic parts of an electrical circuit, their arrangement and condition of current path governs operational conditions of the circuit by certain relationships.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Basic circuit - has four main parts		The student will: a. name the main parts of an electrical circuit and give the function of each part. Source, conductors, load, control device.		
2. Types of Circuits		a. differentiate and demonstrate the types of electrical circuits, e.g. series, parallel, complex. b. define: (1) series (2) parallel (3) complex circuits in terms of number of current paths. c. sketch and define an open circuit and a short circuit. d. with the aid of a schematic diagram, determine circuit operation or non-operation.	Set up different kinds of circuits using open wire circuitry to demonstrate and compare differences in circuit component arrangements and paths for current to follow. Examine various circuit conditions with open, closed or shorted circuitry.	

Notes:

Generalization H: Electrical components are represented by symbols that become schematic diagrams.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Symbols		The student will:		
		a. draw circuit diagrams given the symbols of the parts and components.	Distinguish components and draw their symbols.	
		b. read and explain the component arrangements in the circuit by using a schematic diagram, e.g. series, parallel, etc.	Using some basic components, wire a circuit from a schematic.	
2. Schematics		a. given an electrical circuit, draw a schematic diagram of it.	Draw schematic diagrams from given circuits.	
3. Diagrams		a. identify the following types of diagrams and explain their uses: (i.) pictorial (ii.) floor plan (iii.) schematic (block).	Illustrate and discuss advantages, uses and limitation of electrical diagrams of various type.	

Notes:

Generalization I: Electrical circuits are governed by electrical laws and expressed in formulas.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Ohm's Law		The student will:		
		a. explain the effect on the current in a circuit if the resistance is varied (voltage constant), and effect on current with voltage varied if resistance is constant.	Set up experiments to demonstrate the effects on the current of varying E or R.	
		b. using Ohm's law calculate the current, voltage or resistance in electrical circuits. $I = \frac{E}{R}$		
2. Power		a. define and calculate power consumption or dissipation by using the power formulas: $P = EI$, $P = I^2R$, $P = \frac{E^2}{R}$	Discuss, demonstrate and calculate the wattage of electrical components.	
(i.) Series Circuits		b. memorize that:		
		(i.) I is the common component $I_+ = I_1 = I_2$, etc.		
		(ii.) Total resistance is the sum of the resistors $R_+ = R_1 + R_2 + R_3$, etc.		
		(iii.) Sum of the voltage drops= applied voltage $E_+ = E_1 + E_2 + E_3$, etc.		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) Parallel Circuits		c. memorize that: (i.) E is the common component (ii.) Total line current is the sum of the branch currents (iii.) Total resistance is the sum of the reciprocal		
(iii.) Complex Circuits		d. identify similarities of both series and parallel circuits and their relationship within one circuit.		
3. Kirchhoff's Laws		a. interpret and explain Kirchhoff's Law of current and voltage. b. differentiate these laws as they apply to series and parallel circuits.		

Notes:

Topic X: SOLDERING AND MAKING OF CONNECTIONS IN ELECTRICAL CIRCUITS

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Soldering		The student will: a. define soldering b. giventhe materials, solder them and avoid cold solder joints. c. make connections that are mechanically and electrically strong. d. apply the proper technique in un – soldering.	Make three common splices. Solder these splices, solder flat surfaces to flat surfaces, solder wire to flat surfaces. Solder hook-up wire or components to terminals and remove.	
2. Solderless connectors		a. given varying types of connectors, make solderless connections. b. do basic wiring using solderless connectors in series, parallel and series-parallel circuitry.	Make several connections using different types of solderless connectors. Using a working plank and open wire circuitry, wire the following: (1) Series - 1 switch, 1 light, AC source (2) Parallel - 1 switch, 2 lights, AC source (3) Series-Parallel - 1 switch, 3 lights, AC source.	

Notes:

Topic X: SOLDERING AND MAKING OF CONNECTIONS IN ELECTRICAL CIRCUITS (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		c. use octagon boxes, switch boxes and proper code and wiring techniques. NOTE: With a symbolic and schematic idea of components, it is proposed that a more general approach to electrical-electronics systems be taken. This approach would start with a system and the units making up the system, their function within the system, and finally the components utilized. The function of the components within the units would then be studied as well as major troubles and faults with components.	Closed wire - House Wiring Circuits (1) Series (2) Parallel (3) Controlled light and hot outlet (4) 3-way, 2 switches, one light.	

Notes:

Topic XI: SYSTEMS STUDY

Generalization J: Electrical and Electronic systems incorporate many concepts to perform specific functions. Sum total of circuits working together to perform a specific function is a system.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Audio		Student should study a minimum of four of the systems outlined below. The student will:		
(i.) Transducers are necessary prior to amplification as well as after		a. convert sound waves to electrical waves prior to amplification.	Demonstration microphones, headphones, speakers and phonopickups.	
		b. explain the basic theory of operation of a microphone, headphones and speakers.	Demonstration of a record player amplifier.	
(ii.) A Hi-Fi amplifier system employs several basic electronic units		c. explain the basic theory of operation of a Hi-Fi system and the function of each unit.	Set up a Hi-Fi stereo amplifier arrangement to use a record player, tape input, or some other input system.	
2. Electrical Distribution System		a. explain power distribution to substations.	Discuss and visit a substation. Explain use of and function of transformers and capacitor banks.	
(i.) Transformers				
		b. differentiate between the needs and hardware requirements in residential wiring.	Explain, discuss and tour the school facilities to point out different distribution arrangements. 110, 220 single phase, three phase.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
3. Generating Plants		a. study the different methods of commercial production of electricity. b. observe the supporting and related occupations in power generation and distribution.	Discussion, film or plant visitation.	
4. Broadcast Receiver (i.) Reception consists of interception, detection and amplification		a. with the aid of a block diagram, explain the function of each unit within the receiver system. b. trace the signal through the receiver system and compare inputs and outputs of the units.	Using a demonstration receiver and modular structure, demonstrate the function(s) of each unit of the receiver system. Draw and label a block diagram of a superhet receiver and show the waveforms at input and outputs and outputs of stages. Demonstrate the development of radio reception from a crystal detector to TRF to superhet.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
5. Broadcast Transmitter		a. explain the basic principles of establishing a carrier using the block diagram approach to a basic transmitter. b. explain that modulation is a process of modifying some characteristic of a carrier in accordance with intelligence. c. explain the function of each unit, inputs-outputs, principles of operation, energy transformation, transmission and wave propagation.	Using a demonstration transmitter, demonstrate a carrier and effects on it of a modulating signal. Draw a block diagram of a basic transmitter showing waveforms of inputs and outputs of the units in the system.	
Five other systems which could be studied: Electrical Appliance Electric Motor Digital Device Television Receiver				

Notes:

VI. ELECTRICITY-ELECTRONICS

2. Electricity- Electronics 22A

INTRODUCTION

Electricity-Electronics 22A is a module common to both the Electricity and Electronics majors. It is a pre-requisite to Electricity 32B and to Electronics 22B, 22C and 32A.

The course is designed to give the student sufficient skill and knowledge to be able to effectively achieve in subsequent courses in Electricity or Electronics.

I. OBJECTIVES

The objectives of Electricity-Electronics 22A are:

1. To provide background in the basic principles of active and reactive circuits including their application.

2. To provide opportunities to develop skills in the use of test instruments that apply to active and reactive circuits.

II. CONTENT SUMMARY

1. Alternating voltage and current
   -A.C. power-generation
   -audio and radio signals
   -electrical laws

2. Inductance

3. Capacitance

4. Capacitive reactance

5. Capacitive circuits

6. Alternating current circuits

7. Semi-conductor and vacuum tube diode

8. Power supplies

9. Transistors

10. Electronic tubes

III. REFERENCES

No one text is prescribed, however those marked * are considered most valuable as such.

*Brouwer. *Electricity & Electronic Technology.* General Publishers.

*Grob. *Basic Electronics.*

*Lister. *Electric Circuits and Machines.* 4th Edition. McGraw-Hill, Toronto.

Malvino. *Transistor Approximations.*

Grob & Kiver. *Applications of Electronics.*

Kiver, Milton S. *Transistors.*

De France. *Communications Electronics Circuits.*

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Van Valkenburg, Nooger, & Ninille, Inc. *Basic Electricity.* John F. Rider Publisher, Inc. N.Y.

Laboratory manuals:

Zbar. *Basic Electricity.* 3rd Edition.

Zbar. *Basic Electronics.* 3rd Edition.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Electricity-Electronics 22A

Note:

This is quite a heavy theory course. Some teachers may feel the need to transfer some of the content to the 22B module. In any event, students should be given a review of previous work under the following headings.

1. Safety.

2. Basic Concepts of Electricity.
   Electron theory, electrostatics, electrodynamics, emf, resistance-conductance, conductors and insulators, use and care of meters, sources of emf, electrical units, AC and DC.

3. Basic Circuits.
   Review series circuits, parallel circuits, complex circuits, Ohm's Law, energy and power, Kirchhoff's Laws, voltage dividers.

4. Magnetism and Electromagnetism.
   History, natural and artificial, permanent and temporary, magnetic polarity, magnetic fields, laws of magnets, magnetic effect of current, electromagnets.

5. Electromagnetic Induction.
   Review magnetizing force, field intensity H, Hysteresis, magnetic polarity of a coil, motor action between magnetic fields, Induced emf, Induced current, Leng's Law, Faraday's Law of Induction.

Topic I: ALTERNATING VOLTAGE AND CURRENT

Major: Electricity-Electronic

Generalization A: Alternating current and voltage are used in AC power, audio, radio signals and inducation.

Course: Electricity-Electroni 22A

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. AC Power - generation of AC is basic to understanding of AC circuits		The student will:		
		a. do an experiment to show how an AC sinewave of E or I is generated.	Demonstrate simple generator.	
2. Audio and Radio Signals		a. distinguish between audio and radio frequencies.		
(i.) Analysis of a generated wave helps a student understand the formulas used with the AC source		b. observe, and analyze an AC waveform, e.g. frequency, period, wavelength, angular velocity, phase angle.	Do experiments.	
		c. list the different sources of AC signals - power, AF and RF generators.		
		d. compare frequencies by means of Lissajous patterns.		
3. Compare AC to DC in Producing Power		a. interpret RMS Value, peak-value, peak-to-peak values and amplitude of an AC source. Also, draw and label a sine-wave.		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. Ohm's Law and Power Formulas Apply Directly to AC Circuits With R Only		a. make calculations in AC electrical circuits.		
5. Kirchhoff's Laws		a. state Kirchhoff's Laws. b. analyze circuits by use of Kirchhoff's Laws, Thevenin and Norton theorems.	Lab.	
6. Induction		a. explain single phase generation. b. explain multiphase generation. c. explain three phase generation. d. explain advantages and limitations of 3-phase compared to single phase.	Discuss and demonstrate the phase relationship and displacement of 3-phase power generation and distribution.	

Notes:

Generalization B: The ability of a coil to induce a voltage and oppose current has a much more profound effect on the E and I in AC circuits than it does in DC.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Inductance - of a Coil		a. explain how the opposition to change is produced.	Discuss the effects of back emf as opposition to AC.	
		b. define the units of: (i.) inductance - henry (ii.) self-inductance - henry (iii.) mutual inductance - henry.		
		c. find Lt of: (i.) series connected inductances (ii.) parallel connected inductances.		
2. Phase - Inductance		a. demonstrate the effect of L in an electrical circuit. (i.) oppose change in I (ii.) cause I to lag E by 90°.		
		b. draw the I and E waveforms, vectors and phasors for circuit.		

Notes:

Topic II: INDUCTANCE (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
3. Transformers		a. explain the three uses of transformers: (i.) step-up (ii.) step-down (iii.) isolation.		
4. Inductive-Reactance		a. calculate the opposition to AC	Lab.	
		b. explain how opposition to AC is produced by the back emf or counter emf of self inductance.		
		c. calculate inductive reactances in series and parallel.		
		d. make calculations relative to reaction currents and voltages.	Lab.	
5. Coils		a. explain when a coil is considered to be a choke.	Discuss the use of L in power supply filters to try to maintain output I constant.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
6. Reactance. With Only R in an AC/ circuit there is no no reactive effect		b. discover why a choke can be used as a low pass filter because of its X_L. a. draw the waveforms and vectors for I and E. b. use the voltage triangle c. use the impedance triangle d. show how R affects current in a series RL circuit and in a parallel circuit. e. demonstrate the effects of non-sinusoidal of LR circuits.	Demonstrate vectorial addition. Lab. Demonstrate by the use of vectors. Lab.	

Notes:

Topic III: CAPACITANCE

Generalization C: Capacitance is the ability of a component or circuit to store an electrical charge.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Capacitor Components		a. define a capacitor.	Discuss and demonstrate the structure of a capacitor.	
		b. define an electrostatic field.		
		c. differentiate between different types of capacitors eg. air, paper, mica, electrolytic, etc.		
		d. memorize the color code for capacitors.	Lab.	
2. Testing		a. given a capacitor checker, check capacitors for capacitance, leakage, and power factor.	Lab.	
		b. use a VOM for testing for shorted or leaking capacitors.	Demonstrate use of VOM for making the tests. Lab.	
		c. discuss how the opposition to change is produced.		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		d. demonstrate that the capacity of a capacitor depends upon: (i.) area of plates (ii.) distance between plates (iii.) nature of dielectric.		
3. Capacitors in Circuits		a. discuss and demonstrate ~~that:~~ (i.) series total capacitance (ii.) parallel total capacitance	Lab.	
		b. demonstrate that the effect of C in an electrical circuit: (i.) opposes change in E (ii.) causes I to lead E by 90°.	Lab.	

Notes:

Topic IV: CAPACITIVE REACTANCE

Generalization D: The opposition to AC by a capacitor, is capacitive Reactance $C\tau = 1/2\pi fC$ and is measured in ohms.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Capacitive Reactance		a. discuss how opposition to AC is produced by the charge and discharge of a capacitor.	Discuss opposition to AC by C.	
		b. explain capacitive reactance in parallel and series.	Lab.	
2. Ohm's Law Formula Applies to Capacitive Reactance.		a. make calculations relative to reactive currents and voltages.	Lab.	
		b. demonstrate that because of its χc at f, a capacitor may be used as a coupling or by-pass capacitor.	Discuss and demonstrate the filtering effect of a capacitor.	
		c. differentiate when a capacitor is considered to be a coupling or by-pass capacitor because of its χc and related R.		
		d. explain why a capacitor can be used as a high-pass filter.		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Reacting Effect		a. draw the waveforms and vectors for I and E.		
		b. use the voltage triangle	Demonstrate vectorial addition.	
2. Impedance		a. use the impedance triangle	Lab.	
3. Phase		a. show how R in a C circuit affects current in a series RC circuit and in a parallel circuit.	Discuss and demonstrate by the use of phasors or vectors. Lab.	
4. Time Constant		a. demonstrate the charging and discharging rate of a RC circuit.	Discuss and demonstrate RC time constant ects. Lab.	
		b. discuss the meaning of steady state voltage.		

Notes:

TOPIC VI: ALTERNATING CURRENT CIRCUITS

Generalization E: Reaction of coils and capacitors to AC is fundamentally different from reaction to DC.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. The Effects of L and C on I and E in an AC Circuit are Opposite.		a. with the use of Vectors, demonstrate the opposite effects of L and C.		
		b. explain and calculate Z for series and parallel circuits.	Lab.	
2. Reactive Components Return Energy to Source. Watts Power.		a. distinguish among, real power, apparent power, reactive power watts, VAY, VARY.	Using Vectors, discuss the meaning of each and units of measure.	
3. Unity Power Factor is desirable in Power Distribution. Cos θ = 1		a. demonstrate that at unity power factor effects of L(X_L) and C(X_C) cancel leaving only R in the circuit.	Discuss using Vectors and power panel if one available.	
		b. Demonstrate that I and E are in phase in: (i) a resistive circuit (ii) RLC circuit		
		a. demonstrate impedance at resonance in series and parallel.		

Notes:

Topic VII: SEMI-CONDUCTOR AND VACUUM TUBE DIODES.

Generalization F: Diodes are fast-acting electronic switches with controlled conduction, conducting only when forward biased and used in detection, rectification, switching, limiting and regulations.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Semi-conductors		a. explain the electrical properties of a semi-conductor.		
(i.) Doping		b. explain the need for doping to produce extrinsic semi-conductor material.		
(ii.) PN Junction Diode		c. explain the formation of a diode.		
(iii.) Biasing		d. explain Low-High resistance with forward and reverse bias.		
		e. given an ohmmeter, measure back-to-front resistance ratio and state quality of device. Test semi-conductor diodes on a diode tester.	Lab.	
2. Vacuum Tube		a. explain the construction and Edison Effect of Tubes.		
		b. define biasing as the application of a voltage.		
(i.) Thermionic Emission		c. explain how electro-emission is produced by heat.		

Notes:

Topic VII: SEMI-CONDUCTOR AND VACUUM TUBE DIODES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) Vacuum Tube Diode. Also Used for Detection, Rectification, Switching, Limiting, and Regulation		d. explain conduction in a diode. e. test diodes on a tube tester.	Lab.	

Notes:

Topic VIII: POWER SUPPLIES

Generalization G: Power supplies convert AC to DC through rectification, filtering, and regulation.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Rectification		a. explain how a diode can be used as a rectifier and explain: (i.) how a half-wave rectifier operates (ii.) how a full-wave rectifier operates		
		b. given components and schematic, assemble each rectifier in turn.		
2. Filtering		a. observe the effects of filtering on DC output.	Lab.	
		b. compare the effectiveness of various filter arrangements.		
		c. compare filtering effects of half-wave and full-wave rectification.		
3. Regulation		a. define regulation and distinguish between good and poor regulation.		

Notes:

Topic VIII: POWER SUPPLIES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		b. discuss different devices for regulation. c. given load and no load voltages, calculate % regulation. d. compare the regulation of a full-wave and half-wave power supply.		

Notes:

Topic IX: TRANSISTORS

Generalization H: Transistors are current operated doped semi-conductor solid-state amplifying devices whose parameters are determined by circuit arrangement and electrode biasing. Transistors are replacing vacuum tubes in most electrical-electronic equipment.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Transistors Familiarization		a. explain different transistor basing.		
2. Parameters Alpha Beta		a. observe the effect on Ic of varying Ie. b. calculate the current gain of a common base configuration - alpha. c. observe the effect on Ic of varying Iβ. d. calculate the Beta gain of a common emitter configuration.	Lab.	
3. Transistor Testing		a. test transistors with an ohmmeter and a transistor tester.	Lab.	

Notes:

Topic IX: TRANSISTORS (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. Transistor Amplifier Configurations CE, CB, CC		a. demonstrate biasing methods for each configuration. b. observe and explain the effects of stabilization. c. compare the input and output impedances of different configurations. d. observe and discuss the phase relationships of the signal voltage in the amplifiers.	Lab.	

Notes:

Topic X: ELECTRON TUBES

Generalization I: Electron tubes are voltage operated amplifying devices in which thermionic emission of electrons flowing through the tube could be controlled by charged grids.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Dynamic Characteristics of Tubes		a. observe the transfer characteristics of a tube. b. become acquainted with the use of a tube manual. c. test tubes. d. explain the tube parameters of a triode-transconductance, amplification-factor, and effect plate resistance of A.C.	Lab.	
2. Amplification. How and Why a Tube Amplifies Triodes, Tetrodes, Pentodes		a. observe and be able to explain why and how a tube amplifies. b. observe and discuss distorted signals and causes of it.	Lab.	
3. Tube Troubles		a. list tube troubles and ways to check them.		

Notes:

VI. ELECTRICITY-ELECTRONICS

B. Specific Majors

3. Electronics 22B

AM -FM

I N T R O D U C T I O N

The module Electronics 22B should not be considered all-inclusive. A general outline is provided, allowing a large amount of freedom in developing the course content. The construction of a radio receiver and/or a low power transmitter will add interest and provide an opportunity for practical experience in the study of this material.

I. OBJECTIVES

The objectives of Electronics 22B are:

1. To introduce the student to the theory of radio communication.

2. To enable students to diagnose, measure and service AM - FM circuits, devices and systems.

II. CONTENT SUMMARY

1. Course orientation.

2. Career opportunities.

3. Radio transmission and reception principles.

   -history
   -receiver power supplies
   -radio receiver audio amplifiers
   -AM demodulation
   -automatic volume control
   -AM-IF amplifiers
   -AM converters
   -Radio servicing
   -FM receivers
   -AM transmission theory
   -power amplifiers
   -transmitter tubes
   -transmitter power supplies
   -transmitter controls
   -AM modulation
   -FM transmitters
   -antennas and transmission lines

III. REFERENCES

No one text is prescribed. The following texts should serve as useful references.

Caldwell, Wm. *Practical Transistor Servicing*. Howard W. Sams (Thomas Allen in Canada).

*Grob. *Basic Electronics*. McGraw-Hill Ryerson.

Grob & Kiver. *Applications of Electronics*. (2nd Edition). McGraw-Hill Ryerson.

Marcus, Abraham. *Basic Electronics*. Prentice-Hall of Canada.

Marcus, Abraham. *Electronics for Technicians*. Prentice-Hall of Canada.

Marcus & Levy. *Elements of Radio Servicing*. (3rd Edition). McGraw-Hill Ryerson.

Marcus & Levy. *Practical Radio Servicing*. (2nd Edition). McGraw-Hill Ryerson.

U. S. Government Printing Office. *Theory and Use of Electronic Instruments*.

*Most Useful.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Generalization A: Information on the electronics field and study programs may help students to make wiser career decisions.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Course outline		a. discuss course content, activities, and laboratory procedures.	Class discussions, handouts, tour of facilities.	
2. Career Opportunities		a. discuss career opportunities on the basis of previous; -reading -interviews with counsellors and people in the career -visits to plants and shops where jobs requiring electronics are available.		

Notes:

Generalization B: Safety is of prime importance to the well being of persons and equipment.

ncept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
. Unsafe Act		The student will: a. list the consequences of unsafe acts in the electronics field as they relate to (i.) high voltage (ii.) insulation transformers (iii.) grounding procedures (iv.) others.		
. Unsafe Conditions		a. discuss how to identify conditions which could lead to injuries on the job.		

tes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES

Generalization C: Modulated electromagnetic energy radiated by a transmitter must be amplified and demodulated by a receiving device.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. History				
(i.) Spark gap transmitters with crystal sets were first used		a. recognize and know function of components used in early equipment.		
(ii.) The invention of the vacuum tube revolutionized radio communications		b. acquire some knowledge of historical figures in this area.		
		c. given a small Xmtr and receiver, and some test equipment trace signals through the entire system.	Draw block diagrams of transmitter and receiver showing waveforms and frequencies found throughout.	
2. Receiver Power Supplies				
(i.) Tubes and transistors require DC power		a. recognize various types of power supplies, read schematics of such, identify components and their functions.	A study should be made of AC-DC power supplies, full wave, and AC transistor radio supplies. Students should construct some type of radio power supply such as the AC-DC type or transistor supply operating from an AC source.	
		b. list color codes where applicable and the correct procedure in diagnosing faults.		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) Many tube and transistor radios can operate from several power sources		c. given a transistor radio, determine the chassis ground polarity required.	Study should be made of the ways radios can be operated from several power sources. Included should be an investigation of polarity switching methods used in audio radios.	
3. Radio Receiver Audio Amplifiers				
(i.) Audio Control		a. distinguish between volume controls and switches mounted on them, and checking of each part.	Study and make ohmmeter check of volume control taper. Need for taper.	
(ii.) A Radio Loudspeaker		b. test tubes, transistors, and other common amplifier components. Familiarity with component construction is necessary to recognize faulty items.		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(iii.) Output of the Detector Stage		c. investigate and study: (i.) beam power pentodes, construction and characteristics. (ii.) single ended and push pull amplifiers - tube type. (iii.) push pull transistor amplifiers and auto radio power transistor amplifiers. (iv.) construction of radio power amplifiers powered by supply previously constructed. d. measure stage gains and signal trace audio amplifiers. e. examine voltage amplifiers, methods of coupling signals, phase shifting effects, biasing, etc. Continued construction of a radio receiver's first audio amplifier stage.		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. AM Demodulation An r.f. signal can carry intelligence in the form of amplitude variations		a. given an r.f. generator and some sources of audio, externally modulate r.f. signals and inject these into the detector stage of a radio.	Some examination of AM modulation should be made. An r.f. generator should be used to demonstrate AM Modulation ; use audio tones, record player output, observe on scope.	
5. Automatic Volume Control The audio signal from a detector can be used to control the gain of the receiver's r.f. and i.f. amplifiers		a. given an r.f. generator and voltmeter, observe AVC action in a receiver. b. study: (i.) common AVC circuits and their function. (ii.) variable mu pentodes. (iii.) effects of forward bias changes on the gain of transistors. (iv.) AVC time constants.	An AVC filter to radio under construction.	

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
6. AM-I.F. Amplifiers (i.) The beat frequency difference signal from the converter depends upon the local oscillator frequency (ii.) The IF amplifier stage is designed to operate at one frequency only		a. calibrate an r.f. generator by beating with local radio stations. b. given an r.f. generator and scope or VTVM, do a response check on an IF amplifier and make a graph of the results. c. study: (i.) amplifier desired frequency response. (ii.) advantages of converting all frequencies to IF (iii.) tube IF amplifier (iv.) two stage transistor IF amplifiers (v.) typical gains (vi.) impedance matching construction of an IF amplifier stage.	Students should research some IF frequencies used in the past and how they were chosen. Two r.f. generators should be used to produce beat effects upon a scope.	

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(vii.) capacitive and inductive reactance (viii.) resonance.		
7. A.M. Converters (i.) The superheterodyne receiver		a. determine local oscillator operation by checking for the presence of negative oscillator bias, or by the oscilloscope.	Draw a block diagram of the mixer and local oscillator stages. Add signals and frequencies associated with these blocks. Draw and study typical tube and transistor converter circuits.	
		b. substitute for the local oscillator with an r.f. generator.	Complete radio construction by the addition of a converter stage.	
		c. given an r.f. generator, test for mixer operation.		
		d. investigate some simple antenna designs.		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) Special Design Considerations		e. explain the difference between mixer and local oscillator tuning capacitor sections. f. study tracking and design of tuning capacitors. Examine permeability tuning and facilities for adjustment. g. check minimum and maximum capacities of tuning capacitors. h. explain necessity for trimmers and trimmer effect on total capacity. (Capacitors in series and parallel).		
8. Radio Servicing				
(i.) The converter and IF sections of a receiver require adjustment for proper frequency selection and amplification		a. given an r.f. generator and oscilloscope or VTVM, align receivers correctly.		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) Receiver servicing is a skilled trade. A practical approach from theoretical knowledge is necessary		b. given a faulty receiver, diagnose and remedy common receiver malfunctions. c. list some common faults associated with each stage of a receiver and the servicing approach for their removal.		
9. F.M. Receivers				
(i.) FM r.f. radio waves are shifted in frequency and are not distorted amplitude variations		a. operate FM sweep generators and simulate FM radio station frequencies.		
(ii.) FM receivers are superheterodynes which must recover the audio information from the FM r.f. carrier signal		b. discuss the standard FM broadcast band frequencies. c. draw a block diagram of an FM receiver indicating waveforms and frequencies. List broadcast frequencies and frequency deviation, some familiar FM stations and their frequency.		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(iii.) FM receivers require adjustment and maintainance for maximum performance		d. align FM detectors using sweep generator and oscilloscope. e. study AM-FM receivers, switching performed, dual IF amplifiers, and function. f. do some elementary FM receiver servicing. g. align FM IF transformers and check overall FM receiver alignment. Some FM servicing techniques can be examined and receiver faults listed.	FM detector theory. Use of limiters ahead of detectors. Types of detectors - slope - triple tuned - ratio FM detector response curves. Students should study FM sweep generator block diagram and function.	
10. AM Transmission Theory				
(i.) Electromagnetic energy can be sent out in interrupted or modulated form		a. distinguish between forms of radio transmission and where each type is used. b. list and examine various forms of radio emission - CW - MCW (AM,FM)		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		c. draw a block diagram of an AM transmitter and show associated waveforms. Set up and demonstrate an elementary transmitter.		
(ii.) Oscillators generate the AC signals which can be made to radiate		d. identify common oscillator types (Hartley, Colpitts, etc.) and use a scope on them to determine frequency of operation.		
11. Power Amplifiers				
(i.) R.F. amplifiers develop the necessary antenna radiating power		a. discuss the legal aspects of radio transmitter operation. b. examine: (i.) voltage and power amplifiers (ii.) transmitter tank circuits (iii.) interstage coupling (iv.) neutralization.	Construction of a one tube or transistor r.f. amplifier.	

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) R.F. amplifiers vary in efficiency and output according to their class of operation		c. compare Class A, AB, B, and C, r.f. amplifiers.		
12. Transmitter Tubes Transmitting tubes are more rugged in construction, have higher power ratings, and have special cooling facilities		a. discuss the heat dissipation problems associated with 50,000 watt transmitters. b. draw a transmitter tube.		
13. Transmitter Power Supplies Transmitter power supplies contain design features which enable them to provide the (cont.)		a. realize that transmitters require greater amounts of current from the power supply than receivers, therefore, their design must be different.		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
large amounts of power required from them		b. compare transmitter and receiver power supplies.		
14. Transmitter Controls				
(i.) Certain rectifier tubes require warm up time before the application of power		a. given a relay, be capable of constructing a simple remote control circuit.		
(ii.) The high voltages required in transmitters makes them extremely dangerous to service.		b. discuss the safety procedures associated with electronic equipment.		
(iii.) Many transmitters are operated away from the convenient location of a studio in order to be located at a strategic antenna site				

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
15. AM Modulation (i.) Mixing the output of an r.f. oscillator with an audio signal can produce an amplitude modulated signal		a. given an r.f. generator and some source of audio, transmit audio over short distances which can be tuned in on a radio. b. Examine some common methods of modulation - plate - grid Consideration of under and over modulation, per cent modulation, and methods of monitoring. Idea of sidebands and single sideband operation by amateurs. Other considerations such as high and low level modulation and linear amplifiers.		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
16. FM Transmitters				
(i.) Two basic FM systems are used		a. modulate an FM generator to transmit over short distances to an FM receiver.		
(ii.) The reactance tube is the electronic means of modulating FM		b. draw a block diagram of FM transmitter. Draw basic Armstrong and Crosby circuits and explain operation.		
17. Antennas and Transmission Lines				
(i.) The propagation of radio waves depends upon many factors		a. list the problems which arise as radio transmission frequencies increase. b. research and investigate radio wave propagation with reference to: (i.) polarization (ii.) wavelength and frequency (iii.) ground waves (iv.) sky waves (v.) solar activity (vi.) day and night operation		

Notes:

Topic III: RADIO TRANSMISSION AND RECEPTION PRINCIPLES. (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(vii.) skip distance (viii.) scatter (ix.) terrain.		
(ii.) Proper antenna design is fundamental to efficient radiation of r.f. energy		c. make drawings of and study fundamental antennas such as: - Marconi - Hertz - dipole - vertical towers - inverted L - long wave - high frequency antennas - vertical - doublet - rhombic.		
(iii.) Transmission lines, antennas and transmitters must be be properly matched for efficient energy transfer		d. discuss the importance of selecting the proper wires, cables, and transmission lines in the electronics industry.		

Notes:

VI. ELECTRICITY-ELECTRONICS

B. Specific Majors

4. Electronics 22C

Solid-State I.C.'s
and Special Devices

I N T R O D U C T I O N

This is a five credit course in solid-state I.C.'s and special devices, that together with six other electronic courses make up a 35 credit program.

This course is open to students who have completed Electronics 22A.

Electronics 22C is intended to extend the study of solid-state devices from the original simple transistor to the present integrated circuitry.

I. OBJECTIVES

The objectives of Electronics 22C are:

1. To familiarize the student with the operation of a variety of devices within the solid-state family.

2. To provide students with knowledge of present trends in manufacturing and design of electronic equipment.

3. To enable the student to understand and test various solid-state circuitry.

II. CONTENT

1. Historical Review of Solid-State Electronics.
2. Field Effect Transistors
3. MOS FET Semiconductors
4. Tunnel Diode
5. Silicon Control
6. Integrated Circuits
7. I.C. Amplifiers
8. I.C. Oscillators
9. Applications of I.C.

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*Turner, Rufus P. *A. B. C.'s of Integrated Circuits.* 1st Edition, 1971. Howard W. Sams and Company. Thomas Allen in Canada.

* Most Useful.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic 1: History of solid-state electronics. Major: Electronics

Course: 22C

Generalization A: An overview of solid-state electronics, from a review of transistors, to the study of integrated circuits, and special solid-state devices.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Review (i) definition of a semiconductor (ii) operation of a diode (iii) operation of an NPN, and PNP transistor (iv) basic transistor circuits (v) transistor characteristics and symbols. 2. Development of solid-state electronics.		The student will: a. Review the basic principles of transistor operation, discuss the advantages of transistors and learn of the rapid progress in development of special devices such as F.E.T.'s, M.O.S., F.E.T.'s, Tunnel diodes, S.C.R., light emitting diodes and integrated circuits (I.C.'s). b. Discuss the advantages and application of such devices. c. Discuss the reliability and miniaturization of electronic devices made possible by I.C.'s.	Class discussion of technological achievements due to solid state devices.	

Notes:

Topic 2: The Field Effect Transistor

Generalization B: Field Effect Transistors (F.E.T.'s) exhibit an entirely different set of characteristics from the conventional transistors.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. The Field Effect Transistor (F.E.T.) (i) Controlling drain current (ii) Biasing the gate (iii) Application of F.E.T. (iv) Frequency response of F.E.T.		The student will: a. Compare the F.E.T. with the conventional transistor. b. Learn its operation and application. c. Learn of the advantage in substituting a F.E.T. for a transistor.		

Notes:

Topic 3: M.O.S. Semiconductor

Generalization C: Metal Ozide Field Effect Semiconductor, (M.O.S. F.E.T.), an improved and superior F.E.T.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. M.O.S., F.E.T. Semi-conductor (i) Composition of a depletion-type M.O.S. transistor. (ii) M.O.S. gate resistances. (iii) M.O.S. circuits. (iv) M.O.S. Characteristics.		The student will: a. Discuss the advantages of M.O.S. F.E.T.'s as compared to F.E.T.'s. b. Study the common circuits and application of the M.O.S.,F.E.T.'s.	Lab.	

Notes:

Topic 4: Tunnel Diode

Generalization D: The Tunnel Diode, a device of the solid-state family operates on different principles, compared to transistors.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. The Tunnel Diode (i) Characteristics. (ii) Amplifier circuits. (iii) Voltage gain. (iv) Power gain.		The student will: a. Learn the operation of the tunnel diode. b. Study application of the tunnel diode.		

Notes:

Topic 5: Silicon Control

Generalization E: Silicon Control Rectifiers (S.C.R.'s) as used in power supplies and power regulating circuits.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Silicon Control Rectifiers (S.C.R.'s) (i) Operation of S.C.R. (ii) Application of S.C.R. diodes in circuitry.		The student will: a. Explain the operation of S.C.R. b. List the advantages of S.C.R. in power supplies and power regulating circuits. c. Trouble-shoot S.C.R. circuits.		

Notes:

Topic 6: Integrated Circuits.

Generalization F: Fundamentals of the Integrated Circuits (I.C.'s)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. The integrated circuit (I.C.)		The student will: a. Study the development of I.C. as an out-growth of modular circuitry using transistors, capacitors, and resistors. b. Classify I.C.'s. c. Read I.C. symbols. d. Explain I.C. characteristics. e. Discuss large-scale integration. f. Discuss advantages of I.C.'s. g. Install I.C.'s.		

Notes:

Topic 7: Amplifiers

Generalization G: I.C.'s are very useful for amplifications.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. A. F. amplifiers.		The student will: a. Learn the operation of an I.C. amplifier as applied in the various circuitry, AF, IF and video as well as cascaded use.		

Notes:

Topic 8: Oscillators.

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. A. F. Oscillators.		a. Explain how I.C. oscillators operate. b. Compare I.C. oscillators with conventional types and list the I.C. advantages and disadvantages.		
2. R. F. Oscillators.		a. Explain the operation of an R.F. oscillator. b. Explain operation of crystal controlled R.F. oscillator.		

Notes:

Topic 9: Applications of I.C.

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. I.C.'s in industrial controls.		The student will: a. Become familiar with various types of I.C.'s and their application. b. Describe how I.C.'s operate in various circuitry -in AM receivers -in FM receivers -in T.V. circuits -in stereo amplifiers. c. Do minor tests, and trouble-shoot faults common in I.C. circuits.		

Notes:

VI. Electricity-Electronics

B. Specific Majors

5. Electronics 32A

TV Receivers

I N T R O D U C T I O N

Electronics 32A may be elected following 22A and 22B and C.

This module is designed to provide students with a basic course on television receivers. It will provide students with skills and knowledge of the television system that may lead to employment, complement other high school or post high school studies, or satisfy individual avocational interests. The course will provide students with an opportunity to work with advanced electronic circuitry, of the type present in virtually all homes today. Thus the module provides students with an opportunity to relate their studies to the further understanding of today's advancing technological environment.

The following outline is a guide to providing a basic course in black and white television.

Prior to registering in this module, it is recommended that students have a good understanding of basic electronic and electrical theory, be thoroughly familiar with basic electronic and electrical theory, be thoroughly familiar with basic lab test equipment, and have a good understanding of radio receiver operations and servicing.

I. OBJECTIVES

The objectives of Electronics 32A are:

1. To provide students with the opportunity to work with advanced circuitry and test equipment.

2. To introduce the student to the theory of T.V. receivers.

3. To provide the students with skills in T.V. servicing.

II. CONTENT SUMMARY

1. Introduction to television.
2. Safety.
3. Television receivers.
4. The cathode-ray tube.
5. Television receiver circuitry.

6. The video signal and picture reproduction.
7. Video I-F amplifiers.
8. R. F. tuners.
9. Producing a T.V. signal.
10. Television antennas.
11. The sound circuits.

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*Grob, B. *Basic Television.* 3rd Edition, McGraw-Hill Book Co., 1964.

Kiver, M. S. *Television Simplified.* 6th Edition, McGraw-Hill, 1962.

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Schure, A. *Basic Television.* Five volumes. General Publishing in Canada.

Zbar, P. B. *Basic Television: Theory and Servicing.* 2nd Edition; A Text-Lab Manual. McGraw-Hill, 1971.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic I: INTRODUCTION TO TELEVISION

Major: Electronics

Generalization A: An overall understanding of what this course entails in terms of objectives, activities, standards of performance, evaluations and the opportunities, existing in the career field are of interest to the student.

Course: Electronics 32A (TV Receivers)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Orientation		a. be informed of what to expect from the course, and what will be expected of him. b. be familiar with the organization of lab and classroom activities.	Informal class discussions with teacher.	Curriculum guide.
2. Guidance information for the student: - prerequisites - employment opportunities & information - post-secondary courses - apprenticeship programs		a. discuss the various occupations and training programs available in the career field.	Perusal of guidance circulars, employment want ads, and pamphlets. Discussion of articulation with apprenticeship and technical school programs. Field trip to industry or technical school.	Movies from industry outlining various opportunities in the career field.

Notes:

Generalization B: An active safety program that will generate a safety conscious attitude throughout the class is of prime importance.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Unsafe Conditions		a. recognize potentially hazardous conditions.	Class discussion of potential hazards mentioned by teacher.	Posters, slides or movies. Pamphlets outlining the part played by CSA.
2. Safe procedures and precautions to be followed		a. demonstrate how to begin a job or activity by following safe procedures.	Classroom demonstration followed by question and answer period.	Safety film,e.g. Electrical practices.
3. First aid practices		a. explain basic first aid practices for an electrical lab.	Possible in-service first aid training course.	For further information on developing a well-organized program, contact Worker's Compensation Board or St. John's Ambulance.

Notes:

Generalization C: Selection, processing and reproduction of a TV picture signal involves a wide variety of electronic circuits.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. T.V. Signals (i.) TV cameras (ii.) information present in the composite signal (iii.) equipment at the transmitter		a. describe how varying light intensified from a scene may be converted to an electric signal. b. describe in brief the basic operations of a television transmitting station.		Class members constitute operating crew for CCTV equipment in school field trip to a local TV station.
2. Selection and Reception of a TV Signal		a. compare TV signal reception and selection with radio.		
3. Modification of a TV Signal		a. identify the function of each operational stage in the receiver. b. draw a receiver block diagram complete with location of user controls.		Classroom demonstration of waveforms at test points. Use of TV analyst instrument to demonstrate waveforms.
4. Reproduction of Signals of the Picture Tube		a. explain the CRT and its requirements.	Lab demonstration of CRT operations and adjustments.	Cut-away model of a picture tube.

Notes:

Topic IV: THE CATHODE-RAY TUBE (CRT)

Generalization D: The television picture tube, CRT or Kinescope, is a vacuum tube designed to reproduce a televised scene.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Handling a CRT is Potentially Hazardous		a. describe results when a CRT is ruptured accidentally.	Demonstration of safe-handling practices.	Possible movie of an imploding CRT.
2. The CRT screen converts electrical signals into a visual image		a. observe various CRT tubes during operation to detect different phosphor coatings.	Display of cut-away CRT model. Movie on CRT operation (Tektronix).	
3. Formation and Control of the Electron Beam		a. explain a ray tube, how the ray is formed, controlled, focused, deflected and finally collected.	Student lab jobs may be organized around a demo CRT, observing effects of applying various voltages.	Have an electron gun removed from a dud CRT for display purposes.
4. The Proper Levels of Bias and Amplitude of Video Signal to the CRT are Necessary for a Good Picture		a. measure bias and other control voltages as receiver controls are varied. b. signal trace the video signal to the CRT.	Demonstrate how a television picture can be reproduced on a scope screen.	

Notes:

Topic V: TELEVISION RECEIVER CIRCUITRY

Generalization E: A television receiver utilizes both low and high voltage curcuitry for power, deflection and detection.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Low Voltage Circuit				
(i.) Vacuum Tube and Semiconductor Devices are Employed in-TV Low Voltage Supplies		a. list the common supplies, including transformer and transformerless types, doublers and stacked arrangements.	Breadboard assembly of the basic types, enabling students to do operational checks and become more familiar with the circuits. Operational checks of supplies used in TV's.	
(ii.) Trouble shooting in TV receivers invariably involves the low-voltage supply		b. detect a variety of operational defects.		
2. High Voltage Circuits In Television Receivers		a. describe H.V. power supply functions, requirements, hazards, components, and test procedures.	Practical lab exercises that include tests and measurements on operative and non-operative H.V. circuitry and components.	
(i.) The H.V. Flyback Transformer		b. analyze and draw the circuit.	Practical exercises that familiarize the student with circuits and components used.	

Notes:

Topic V: TELEVISION RECEIVER CIRCUITRY (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) H.V. Circuitry Design		a. explain the differences between H.V. components, circuitry, and their conventional counterparts.	Familiarization with construction of H.V. components. H.V. test procedures and how to remedy circuit defects.	
(iii.) Servicing H.V. Supplies		b. demonstrate proper techniques and procedures required for work on H.V. circuitry.		
3. Horizontal and Vertical Deflection Circuits				
(i.) The Operation of Deflection Circuitry Can Be Checked From an Analysis of Wave Forms		a. sketch the normal shapes of deflection waveforms, and be able to detect abnormal conditions. b. describe the operation of all stages.	Students compare and contrast operations of defective and nondefective demonstration models.	
(ii.) The Number of Stages Required to Accomplish H & V Deflection May Vary Between Receivers.		c. explain what is involved in deflection circuitry, including functions and requirements of the various stages.	Block diagrams may be drawn of common H & V systems.	

Notes:

Topic V: TELEVISION RECEIVER CIRCUITRY (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(iii.) The Vertical Oscillator is Synchronized With the TV Transmitting Station		d. wire up and operate the common circuits.	Laboratory exercises that concentrate on familiarization through waveform analysis.	
(iv.) The Horizontal Oscillator is Synchronized With the TV Transmitting Station		e. wire up and operate the circuit.		
(v.) The Vertical Deflection Amplifier		f. explain the varied functions and requirements of this stage.		
(vi.) The Horizontal Deflection Stage		g. explain the function of the horizontal deflection stage.		

Notes:

Topic V: TELEVISION RECEIVER CIRCUITRY (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(vii.) Servicing Deflection Circuits by: - visual analysis - instrument analysis - test points - voltage and resistance analysis - parts replacement - adjustment of controls - service procedures		h. signal trace circuits and components with television analyst instrument. i. service defective receivers.		
4. Synchronization Circuits (i.) Synchronized Circuits in a Receiver Are Controlled by the Transmitters		a. describe how sync signals keep scanning of the raster in step with picture information in the video signal. b. outline the basic circuits in block form.		

Notes:

Topic V: TELEVISION RECEIVER CIRCUITRY (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(ii.) The Decoding of Sync Pulse Signals is a Major Function of These Circuits		c. explain how clipping, shaping, sorting, etc. of signals are achieved.	Students should follow the path of sync signals, thereby helping to understand circuit functions.	
(iii.) The Operations of Pulse Circuitry are Largely Dependent Upon Integration and Waveforms		d. explain (i.) separation of sync pulses (ii.) importance of time constants.		
(iv.) Servicing Sync Circuits May Entail: - visual analysis of picture - signal tracing - voltage waveform tests - components replacement and adjustment - conventional service procedures		e. outline a trouble shooting procedure and follow it when looking for sync circuit faults.	Servicing of receivers with sync defects or inserting faults in lab receivers.	

Notes:

Topic VI: THE VIDEO SIGNAL AND PICTURE REPRODUCTION

Generalization F: Detecting, amplifying, filtering and regulating the video signal are important functions in a television receiver.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. The Video Detector		a. find similarities to the second detector in a superhet radio. b. explain where the video detector output is destined for. c. explain why a certain signal polarity is used.	Signal tracing of various working receivers.	
2. The Video Amplifier		a. explain the importance of this stage in relation to the picture tube's operation.	Laboratory exercises that include observation of the effects that various video AMP and CRT circuitry controls have on the picture.	
3. Wave Trap and Filter Circuits		a. explain the need for this circuitry in TV receivers.	Laboratory exercises designed to clarify the operation of this circuitry.	
4. Automatic Control of RF Carrier Amplifiers		a. explain the purpose of A.G.C. voltage and the operation of those circuits most often used.	Observation of signal waveforms and voltage with their effects on the RF carrier amplifiers.	

Notes:

Topic VI: THE VIDEO SIGNAL AND PICTURE REPRODUCTION (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
5. Pedestal Voltage		a. explain the need for preserving the DC component of the video signal.	Laboratory exercises that will acquaint students with the various ways in which the DC level is retained or restored.	
6. Malfunctions in Video Signal Circuits		a. explain the problems that can arise in the detector, video amplifier, AGC and other associated circuitry.	Laboratory exercises on receivers that have faults inserted or simply illustrate common defects.	

Notes:

Generalization G: The super-heterodyne television receiver uses several IF stages to amplify the RF carrier signal waveform.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Operations of the I-F Strip		a. describe the gain, selectivity and response characteristics of I-F strip.	Laboratory demonstration of I-F response curve and the factors affecting its shape. Student practical exercises.	
2. Bandwidth of the FR Carrier Waveform		a. explain the frequency response characteristics of a carrier wave.	Some exercises on frequency response curves.	
3. A Number of Special Circuit Considerations are Employed in I-F Strip		a. explain the effects of traps, bank filters, damping components, staggered tuning, and other factors affecting tuned amplifiers.		
4. Variations in I-F Strips in Superheterodyne Television Recievers		a. discuss the variety of I-F amplifying circuits.	Laboratory exercises planned around a variety of different receivers.	
5. Servicing the I-F Strip		a. service defective equipment in accordance with trade procedures.		

Notes:

Topic VIII: R-F Tuners

Generalization H: The "Front End" of a TV receiver will select the desired signal and convert it to an intermediate carrier signal frequency.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. The R-F Tuner		a. explain the basic types of circuits employed in a tuner.	Theoretical class exercises that will acquaint students with signal frequencies, frequency conversions and other tuner functions.	
2. Amplifier, Oscillator, and Mixer Circuits		a. explain signal to noise ratio, frequency stability, tuning, etc.	Investigation of the various types of circuits used in most tuners.	
3. The Construction and Assembly of Tuner Components		a. list the mechanical and circuit problems encountered in the make-up of tuners.	Examination of various tuner assemblies.	

Notes:

Topic IX: PRODUCING A TV SIGNAL

Generalization I: The production of a TV signal begins at a camera that converts the scene into an electrical signal.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Resolution of the Televised Scene is Dependent on TV picture elements		a. explain the elemental structure of video reproduction.	Examination of picture elements in various photographs, newspaper reproductions and TV images.	
2. The Electron Scanning Beam of a Camera is the Intermediary of the Studio Scene and TV Signal		a. explain the necessity of interlaced and synchronized scanning of the projected scene. b. discuss the details of scanning frequencies, patterns and standard size. c. outline operation of: - flying-spot scanner - image orthicon - vidicon - plumbicon.	Mapping out on paper the pattern followed by the electron beam in scanning the image screen. Activities or exercise that will familiarize the student with scanning problems that may arise at the studio or at the receiver.	
3. TV Camera Tubes		a. explain how various camera tubes can produce an electrical signal that represents the studio scene.		

Notes:

Topic IX: PRODUCING A TV SIGNAL (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. Characteristics and Constituents That Make Up the Composite Video Signal		a. illustrate and describe the sequence of pulses and signals in scanning an entire field or frame. b. explain government standards of transmission. c. explain the importance of picture qualities in a video reproduction, such as brightness and contrast.	Experimentation with a camera connected to a monitor to illustrate these physical characteristics.	

Notes:

Topic X: TELEVISION ANTENNAS

Generalization J: The transmitted electromagnetic waves in space are intercepted by the TV receiver antenna, providing an electrical signal current at the receiver input.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. The Antenna		a. explain basic antenna theory.		
(i.) An Antenna is a Conductor		b. set up an antenna hook-up.		
(ii.) Variety of Antennas is Available to Suit Every Need		c. list the various types of antennas and know how to select one for a specific use.		
(iii.) Sometimes Electromagnetic Waves are Directed to Their Destination by Cable		d. explain cable transmission with its pros and cons.	A look at cable installations. Various lab activities to include the attaching of various types of connectors to coaxial cable.	

Notes:

Topic XI: THE SOUND CIRCUITS

Generalization K: With the TV Sound Signal FM modulated, the sound section resembles a typical FM radio receiver.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Carrier Wave		a. explain the advantages and disadvantages of using FM, as well as the basic principles.	Scope, movie, filmstrip or transparency demonstration of an FM signal. Review of basic principles of FM transmission.	
2. Basic Differences Between an FM Receiver and an AM Receiver		a. explain the similarities and differences of the receivers. b. draw block diagrams to compare the two types of receivers.		
3. FM Signal Conversion		a. explain the circuit and operation of the popular types of FM detectors.	Practical lab exercises that facilitate the understanding of FM detectors.	
4. Servicing		a. use correct procedures to service the audio section.	Complete alignment of the audio section beginning with 4.5 Mc. sound take-off.	

Notes:

VI. ELECTRICITY-ELECTRONICS

B. Specific Majors

6. Electronics 32B

Computer and Instruments

I N T R O D U C T I O N

This module consists of content in the areas of computer logic and instrument theory and use. Teachers are not expected to teach all the concepts listed in this guide but rather to select the material appropriate to their class and facilities. The content may be drawn exclusively from either the digital logic portion or instruments, or a combination of both. It is anticipated as the computer potential grows, the special instrument section will be phased out.

I. OBJECTIVES

The objectives for the computer course are to:

1. Familiarize students with the digital logic field of electronics.

2. Give students the opportunity to learn basic binary concepts, logic circuits, and study some selected practical subsystems.

II. CONTENT SUMMARY

A. Computer

1. Basic binary and Boolean algebra concepts.
2. Codes.
3. Logic systems.
4. Practical systems.

and/or

B. Instruments

1. Career field study.
2. Measurement and measuring devices
   - -meters
   - -bridges
   - -oscilloscopes
   - -semiconductor testers
   - -tube testers
   - -signal generators
   - -capacitance checkers.

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IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic I: BASIC BINARY AND BOOLEAN ALGEBRA CONCEPTS. MAJOR: Electronics 32B

Generalization A: Binary arithmetic and Boolean algebra are necessary tools when dealing with digital circuitry. COURSE: Computer (Digital Logic)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Number Systems (i) General Expression -the binary number system -the octal number system (ii) Conversion from Binary to Decimal and vice versa (iii) The Octal Number System -octal to decimal conversion -decimal to octal conversion -octal to binary and binary to octal conversions.		The student will: a. write the general expression for any number system using the notation of the decimal system and substitute in this expression the correct constants for the binary and octal systems. b. convert a mixed number in one number system to an equivalent number in any other number system.		

Notes:

Topic BASIC BINARY AND BOOLEAN ALGEBRA CONCEPTS

MAJOR: Electronics 32B

Generalization

COURSE: Computer (Digital Logic)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Number Systems cont'd.				
(iv) Binary Arithmetic -addition -multiplication -subtraction -division		a. solve binary arithmetic problems involving addition, multiplication, subtraction and division.		
2. Boolean Algebra				
(i) Variables, Operators, Identities, Expressions, Laws and Theorems -Boolean algebra variables -the OR function -the NOT circuit		a. identify and define Boolean algebra variables, operators, identities, expressions, laws and theorems. b. generate a truth table from a given B.A. expression. Given a Mil. Std. logic circuit diagram with inputs, the student will be able to write the output expressions for the circuit.		

Notes:

Topic BASIC BINARY AND BOOLEAN ALGEBRA CONCEPTS

MAJOR: Electronics 32B

Generalization

COURSE: Computer (Digital Logic)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
2. Boolean Algebra cont'd (i) cont'd. -laws -the commutative law -the associative law -the distributive law -theorems -DeMorgan's Theorem -review and summary of operators, identities, laws, expressions and theorems.		c. apply the three laws and/or theorems when reducing or rewriting Boolean expressions. d. use the required variables, operators, identities, laws, expressions and theorems when working with Boolean algebra.		

Notes:

Topic II: CODES

MAJOR: Electronics 32B

Generalization B: Certain arrangements of ones and zeros (codes) are preferred over others for specific applications for a variety of reasons.

COURSE: Computer (Digital Logic)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Examples of Codes from the Wide Variety in Use.				
(i) -Binary Coded Decimal -Excess Three Code -Two out of Five -Gray Code -ASCII Code -Shift Counter Code		a. write a description of the unique characteristic(s) of each of the following codes: -BCD 8421 -Excess Three -Two out of Five Code -Gray -ASCII -Shift Counter		
(ii) Parity in Codes -even parity -odd parity				

Notes:

Topic III: LOGIC CIRCUITS

MAJOR: Electronics 32B

Generalization C: Logic Circuits are the necessary hardware elements which process signals in a predetermined fashion in digital systems.

COURSE: Computer (Digital Logic)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Logic Elements (i) Gates -military standard symbology for gates -AND gate -OR gate -INVERTER - NAND -NOR -NEGATED INPUT OR -EXCLUSIVE OR		a. given the name of the gate, draw its Mil. Std. symbol and write its truth table. Given the symbol for a gate, the student must be able to correctly identify it. b. the student will demonstrate the operation of some of the common 7400 series integrated circuit gate chips.		
(ii) Flip-Flops (Bistable Multivibrators: R-S, D TYPE, J-K) -characteristics -equations		c. correctly draw and label the block diagram of a J-K flip-flop and write an explanation of its operation in terms of signals and levels at the input. d. given the schematic diagram, write equations for interconnected flip-flops.		
-state diagrams		e. generate state diagrams for flip-flop circuits.		

Notes:

Topic IV: PRACTICAL I.C. LOGIC CIRCUITS — MAJOR: Electroncis 32B

Generalization D: The availablity of a variety of TTL integrated circuits facilitate the construction of digital subsystems. — COURSE: Computer (Digital Logic)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. (i) Light emitting diodes and seven segment displays		a. demonstrate the operation of some of the more common seven segment displays available on the market.		
(ii) Decoders		b. demonstrate the operation of a few common decoders. (1) 4 line to 10 line decoder (2) 4 line to 7 line decoder (3) 4 line to 16 line decoder		
		c. using a seven segment read-out and an appropriate 4 line to 7 line decoder/ driver construct a seven segment display.		
(iii) Decade Counters		d. using a 7490 ic chip connected to a seven segment display construct a decade counter.		

Notes:

Topic IV: PRACTICAL I.C. LOGIC CIRCUITS

MAJOR: Electronics 32B

Generalization

COURSE: Computer (Digital Logic)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		e. Construct a two, three or four decade counter by cascading the counter above in (d).		
		f. Employ the cascaded decade counter to measure frequency and/or capacitance.		
(iv) De-multiplexers, multiplexers and sequencers		g. distinguish between multiplexer, de-multiplexer and sequencer.		
		h. construct sequencers from the appropriate 7400 series i.c.'s.		
		i. construct de-multiplexers from the appropriate 7400 series i.c.'s.		
		j. construct multiplexers from 74150 and 74153 i.c.'s.		
(v) Flip-flops and monostable multivibrators		k. demonstrate the operation and behaviour of some of the more common 7400 series i.c.'s as either flip-flops or latches or both.		

Notes:

Topic IV: PRACTICAL I.C. LOGIC CIRCUITS

MAJOR: Electronics 32B

COURSE: Computer (Digital Logic)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
(vi) Registers, Counters and Arithmetic elements		l. demonstrate the operation of a monostable vibrator using a 555 i.c. m. demonstrate the operation of a "7400" series i.c. shift register. n. demonstrate the operation of asynchronous binary counter using 7400 series i.c.'s. o. construct binary adders and subtractors using 7400 series i.c.'s.		
* Optional (vii) Semiconductor memories -RAMS -ROMS		p. demonstrate the operation of a 7489 or 74170 RAM q. demonstrate the use of a BCD to seven segment decoder/driver as a read only memory.		

Notes:

Section B Instruments

Topic I: CAREER FIELD STUDY

Major: Electronics 32B

Generalization A. Information on the electronics field may help a student make good decisions and take wise actions.

Course: Instruments

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. The organization of the instrument module is an examination of a number of devices and instruments		The student will: a. list the major devices and instruments to be studied.		
2. The instrument module is part of the high school electronics program		a. identify the other modules in the program.		
3. The electronics program in the high school can lead to other programs at the post secondary level and in industry		a. describe the electronics programs at SAIT/NAIT.		

Notes:

Topic I: CAREER FIELD STUDY (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. The instrument field like any other part of electronics requires a safety consciousness on the part of its workers		a. recognize the hazards of electrical shock, i.e. how various levels of current affect the human body. b. identify common working situations where risk exists. c. recognize the dangers of chemicals, their bases, and additives that are commonly found in instrument work. d. given various chemicals discuss their safe use. e. recognize common problems in the safe operation of hand tools, air lines, etc. f. outline procedure to be followed after an accident in the lab involving shock, chemicals, and/or power tools. g. demonstrate in day to day activity a safety consciousness.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES

Generalization B: Measuring instruments allow us to observe circuit conditions of voltage, current, resistance, and other parameters.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Meters		The student will: a. describe the "motor action" which is basic to d.c. current meters. b. describe the operation and construction of the taut-band and D'arsonval movement. c. compare and contrast the above meter. d. convert a given movement to read greater currents by the calculation of the required shunts.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		e. Calculate range resistors to produce a multirange voltmeter. f. calculate values for series and shunt multirange ohm meters. g. outline the problems of accuracy e.g. temperature, non-linearity of rectifiers, etc. h. given the accuracy of a meter and a reading, compute the limits of the true value. i. take readings from instruments, free of paralax error as judged by the instructor. j. given various conditions select a probe or meter to minimize loading. k. calculate the loading effects of a voltmeter in D.C. cct.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		n. sketch and explain the balanced transistor or tube cct that is the basis of the VTVM/TVM instruments. o. calibrate a meter to bring it within the manufacturer's original specifications. p. given a number of diodes arrange them in order of their leakage current. q. given a number of transistors rank them in terms of tela-tive HFE. r. research and outline methods for the measurement of various paraments of other components, devices, etc.		
2. Bridges		a. rank the various null de-vices according to their sensitivity. -galvanometer -ear phones -oscilloscopes -magic eyes.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		b. given the information that a bridge has been nulled and given the resistance of three arms solve for the fourth arm. -Whealstone bridge c. given various unknown resistors, capacitors, etc. find their value on a commercial bridge. -Maxwell bridge.		
3. Oscilloscopes		a. describe with sketches, the construction of the CRT. b. sketch a block diagram of the vertical section of an oscilloscope. c. trace by means of a second oscilloscope the path of the applied signal through the vertical section of the scope. d. state the sources from which this sweep voltage may come.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		e. state the sources from which sweep voltage may come. f. trace the horizontal switching arrangements on an oscilloscope schematic to show the line, external generator, and internal sweep generator provide horizontal deflection. g. explain through the use of graphs why only linear sweep will present an undistorted view of the vertical signal. h. by the use of graphs explain by sweep in two directions will confuse the display. i. by graphs, explain how information can be lost to long retraces. j. sketch and describe the operation of various multivibrator ccts.		

Notes:

Topic

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		k. sketch and describe the operation of a Schmitt trigger. l. with sketches explain the operation and application of: -low capacitance probes -high voltage probes -demodulator probes. m. demonstrate the measurement of current, voltage, phase, etc. n. with an imaginary fault in an oscilloscope, describe the loss of functions that occur. o. with a real fault placed in a service type oscilloscope isolate the fault through the function lost and find it through signal tracing. p. research/devise tests to check the scope's original specifications.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. Semiconductor Testers		a. describe the significance of I_{co}. b. describe how I_{co} is measured with a cct sketch. c. demonstrate I_{co} measurements on a tester. d. sketch and describe a cct to measure H_{FE}. e. demonstrate the measurement H_{FE}. f. describe the terms at left and sketch the cct's that measure them. g. demonstrate the measurement of the parameters at left if available on equipment held.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
5. Tube Testers		a. describe the cct that checks for element shorts. b. demonstrate a short test. c. explain the cct for a gas test. d. demonstrate a gas test on a commercial tube checker. e. explain the cct for heater to cathode leakage. f. demonstrate he can test a tube for heater to cathode leakage. g. explain the circuitry for the measurement of noise and microphonics. h. demonstrate the use of a tube checker for noise and microphonics. i. explains the cct used in the life test. The student will demonstrate a life test and interpret the reading.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		j. explain the emission test, the cct used and its limitations as a test. k. explain the cct for a mutual conductance test. l. demonstrate he can conduct a mutual conductance test on a commercial tube tester.		
6. Signal Generators		a. sketch and describe the operation of the many common sinewave oscillators. b. locate the buffer amplifier in schematic diagrams of RF signal generators. c. locate attenuators on schematic diagrams. d. sketch the various simple attenuators and discuss their problems. e. describe a simple modulation system as found on service type generators.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		f. measure the percentage of modulation on a signal generator. g. demonstrate that calibration is within the manufacturer's specifications by comparing the signal generator's frequency against a standard like WWV. h. describe how an overdriven amplifier produces a square wave. i. describe how a sinewave source can trigger a multivibrator to produce a square wave. j. sketch and describe the operation of these oscillators. k. demonstrate the use of a square wave generator in the analysis of an audio amplifier.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		l. interpret the resultant wave form in terms of high, low frequency loss, phase shift, and component problems. m. signal trace an audio amplifier and compute the voltage gain and loss. n. describe how an ac voltage applied to a variactor diode can control capacitance and hence sweep an oscillator over a frequency range. o. describe a reactance tube modulator p. describe the variable reluctance method of frequency modulation. q. identify the marker oscillator on a schematic of a commercial generator.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
7. Capacitance Checkers		r. describe the use of a marker oscillator. s. set up the sweep generator and oscilloscope to trace the response curve of a TV booster amplifier on TV tuner cct. a. sketch the schematic and pictorial diagram of a magic eye tube. b. describe how a control voltage can open and close the eye. c. sketch the simplified version of the bridge used to measure resistance. d. sketch a simplified version of the bridge used to measure capacitance. e. describe how a leakage current will effect the magic eye.		

Notes:

Topic II: MEASUREMENT AND MEASURING DEVICES (Cont'd)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		f. show how changes in the resistance of the power factor control will oppose leakage current and how the magic eye will be effected. g. demonstrate his knowledge of the capacitance checker by finding other applications for the device. (bias supply, diode checker, etc.)		

Notes:

VI. ELECTRICITY-ELECTRONICS

B. Specific Majors

7. Electronics 32C

Open Module

I N T R O D U C T I O N

The last module of the Electricity-Electronics sequence is open to students who have completed 30 credits or 6 modules in the major. The 32C course may be taken for 5 or 10 credits.

The time may be used to:

a. provide greater depth to content taken previously. Individual students, groups of students or whole classes may elect to study an area in more detail. This in-depth study could be in Industrial Electronics, Color T.V., Computer, or any of the topics previously started.

b. engage in actual job training under a work experience plan whereby the Electronics teacher acts as coordinator between the student and industry.